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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 698-702

www.thepharmajournal.com
Received: 01-01-2022
Accepted: 09-02-2022

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Influence of split application of fertilizers, pruning month and foliar spray of growth regulators on soil and leaf nutrient content in *Jasmine sambac* cv. Mysuru Mallige

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Abstract
An experiment was conducted on *Jasminum sambac* cv. Mysuru Mallige to study the effect of split application of fertilizers, pruning months and foliar spray of growth regulators in soil and leaf nutrient contents in College of Horticulture, Mysuru during 2019-2021. The design used for the experiment was FRCBD with three replications and three factors: pruning month, growth regulators and fertilizers application. The study revealed that, plants pruned during September month with foliar spray of nitrobenzene at 3 ml/l and split application of fertilizers at alternative month recorded maximum available soil and leaf nutrient status like NPK content.

Keywords: Geographical indication, jasmine, soil nutrient, split application of fertilizers

Introduction
Jasmine is one of the most important loose flowers in India growing an area of 25.53 thousand hectare with an annual production of 187.19 thousand tonnes (Anon., 2017) [1] and it belong to the family Oleaceae and have more than 200 species, among them only four species are commercially cultivated in India *viz., Jasminum sambac, J. gradiflorum, J. multiflorum and J. auriculatum.* The cultivar Mysuru Mallige belongs to sambac group, has got geographical indication (G.I) states in 2006 from Government of India for its fragrance and flowering characters like short corolla tube, boldness of the flower *etc.*, Mysuru Mallige is commercially cultivated in Mysore and Mandya regions of Karnataka and flowers are used for making garlands, women hair adornments, oil extraction etc., it has got huge demand in local market for its fragrance and boldness of the flower.

Among the various factors responsible for high crop yield, supply of appropriate quantity of nutrients at appropriate time plays a vital role in enhancing the quality, productivity and flowering period in jasmine since it is a nutrient loving crop. Hence, split application of major fertilizers like Nitrogen, Phosphorus and Potash (NPK) will meet the specific nutrient requirement of the crop at a specific period helps to initiate the flowering both in on-season as well as off-season (Rao and Sushma, 2016) [10]. Application of nitrogen increases the growth of the plant, yield and quality. Apply of phosphorus to the plant helps to form new roots and make flowers. Potassium plays a major role in making strong stems and keep growing fast. Keeping these points in view, the present investigation was carried out to study the effect of split application of fertilizers, pruning month along with spray of growth regulators on off-season flower induction of jasmine flower with enriching the soil nutrient status.

Material and Methods
The experiment was conducted at college of Horticulture, Mysuru, Karnataka. The soil of the experimental farm was red sandy loam with almost uniform fertility having a pH range of 6.0-6.5. The experimental field is located at the latitude and longitude of 12.2958° North and 76.6394° East, respectively at an altitude of 763 meters above the mean sea level. The maximum and minimum temperatures of the station during the experimental period were 33.80 °C and 16.40 °C, respectively.

Three year old *Jasminum sambac* cv. Mysuru Mallige plants were selected for the experiment and treatment were imposed by adopting different pruning months, different concentration of growth regulators and split application of fertilizers. The experiment was laid out in Factorial Randomized Block Design with 3 replications and 3 factors *Viz.*, pruning month, foliar spray of growth regulators and fertilizers application interval. The treatments details are presented in table 1.

Pruning was done at the level of 30 cm above the ground using pruning shears. Pruning was done according to the treatments in the month of August, November and January respectively. The plant growth regulators (Gibberlic acid and Nitrobenzene) were sprayed 15 days after pruning according to the treatment. The sprays were given during early morning hours with a hand pressure sprayer. A wetting agent was added as a sticker to the spray solution at one ml per liter of solution. Care was taken to prevent drifting of the spray to other plants by using polythene sheet around the plant. Approximate volume of spray to each plant at a time was 100 ml. Well decomposed Farm yard manure (FYM) was applied at the rate of 10 kg per plant. The manure and fertilizers were applied at 15 cm depth in rings and 30 cm away from the main stem. The plants were supplied with 60g of nitrogen, 120 g of phosphorus and 120 g of potassium per plant according to the different treatments.

For soil sample collection, the experimental field was homogeneously divided into 8 blocks. From each block 10-12 sample were collected by digging the soil up to 15-20 cm in V-shape by using spade. Then thick slice of soil from top to bottom of exposed face of v- shape cut soil was collected. All the samples are mixed thoroughly and foreign materials like roots, stones, pebbles and gravels were removed. Then the sample was reduced to half to one kg by using quartering method and final sample are brought lab for analysis. Soil samples were collected before and after imposing treatments. pH, EC and soil nutrient status (Available N, P and K) were analyzed by standard methods *viz.*, pH (pH meter, Jackson 1958), EC (EC bridge, Jackson 1958), available N (Alkaline permanganate method), P_2O_5 (Bray and Kurtz 1947) K_2O (Neutral normal ammonium acetate extract using flame photometer). To know the leaf nutrient status, the leaf samples were collected from the top, middle and bottom portion of the plant at robust vegetative growth stage.

The collected leaf samples were dried (at 65 °C ± 5 °C until constant weight), ground and passed through a 40-mesh sieve and further leaf samples were analyzed by using standard methods of estimation *viz.*, leaf N (Micro-kjeldahl method), P (Vandomolybdo phosphoric yellow colour method) and K (Flame photometry method) as suggested by Jackson, 1958. The data collected was subjected to statistical analysis as per Panse and Sukhatme (1978).

Table 1: Treatment details

Treatment No.	Treatment combination	Treatment details
1	$P_1G_1F_1$	September month pruning + GA_3 at 10ppm + Split application of RDF at twice in a year
2	$P_1G_2F_1$	September month pruning + GA_3 at 20ppm + Split application of RDF at twice in a year
3	$P_1G_3F_1$	September month pruning + GA_3 at 30ppm + Split application of RDF at twice in a year
4	$P_1G_4F_1$	September month pruning + Nitrobenzene at 2 ml /lt + Split application of RDF at twice in a year
5	$P_1G_5F_1$	September month pruning + Nitrobenzene at 2.5ml /lt + Split application of RDF at twice in a year
6	$P_1G_6F_1$	September month pruning + Nitrobenzene at 3 ml /lt + Split application of RDF at twice in a year
7	$P_1G_7F_1$	September month pruning + Water spray + Split application of RDF at twice in a year
8	$P_1G_1F_2$	September month pruning + GA_3 at 10ppm + Split application of RDF at alternative month
9	$P_1G_2F_2$	September month pruning + GA_3 at 20ppm + Split application of RDF at alternative month
10	$P_1G_3F_2$	September month pruning + GA_3 at 30ppm + Split application of RDF at alternative month
11	$P_1G_4F_2$	September month pruning + Nitrobenzene at 2ml /lt + Split application of RDF at alternative month
12	$P_1G_5F_2$	September month pruning + Nitrobenzene at 2.5ml /lt + Split application of RDF at alternative month
13	$P_1G_6F_2$	September month pruning + Nitrobenzene at 3 ml /lt + Split application of RDF at alternative month
14	$P_1G_7F_2$	September month pruning + Water spray + Split application of RDF at alternative month
15	$P_2G_1F_1$	November month pruning + GA_3 at 10ppm + Split application of RDF at twice in a year
16	$P_2G_2F_1$	November month pruning + GA_3 at 20ppm + Split application of RDF at twice in a year
17	$P_2G_3F_1$	November month pruning + GA_3 at 30ppm + Split application of RDF at twice in a year
18	$P_2G_4F_1$	November month pruning + Nitrobenzene at 2 ml /lt + Split application of RDF at twice in a year
19	$P_2G_5F_1$	November month pruning + Nitrobenzene at 2.5ml /lt + Split application of RDF at twice in a year
20	$P_2G_6F_1$	November month pruning + Nitrobenzene at 3 ml /lt + Split application of RDF at twice in a year
21	$P_2G_7F_1$	November month pruning + Water spray + Split application of RDF at twice in a year
22	$P_2G_1F_2$	November month pruning + GA_3 at 10ppm + Split application of RDF at alternative month
23	$P_2G_2F_2$	November month pruning + GA_3 at 20ppm + Split application of RDF at alternative month
24	$P_2G_3F_2$	November month pruning + GA_3 at 30ppm + Split application of RDF at alternative month
25	$P_2G_4F_2$	November month pruning + Nitrobenzene at 2 ml /lt + Split application of RDF at alternative month
26	$P_2G_5F_2$	November month pruning + Nitrobenzene at 2.5ml /lt + Split application of RDF at alternative month
27	$P_2G_6F_2$	November month pruning + Nitrobenzene at 3 ml /lt + Split application of RDF at alternative month
28	$P_2G_7F_2$	November month pruning + Water spray + Split application of RDF at alternative month
29	$P_3G_1F_1$	January month pruning + GA_3 at 10ppm+ Split application of RDF at twice in a year
30	$P_3G_2F_1$	January month pruning + GA_3 at 20ppm+ Split application of RDF at twice in a year
31	$P_3G_3F_1$	January month pruning + GA_3 at 30ppm+ Split application of RDF at twice in a year
32	$P_3G_4F_1$	January month pruning + Nitrobenzene at 2 ml /lt + Split application of RDF at twice in a year
33	$P_3G_5F_1$	January month pruning + Nitrobenzene at 2.5ml /lt + Split application of RDF at twice in a year
34	$P_3G_6F_1$	January month pruning + Nitrobenzene at 3 ml /lt + Split application of RDF at twice in a year
35	$P_3G_7F_1$	January month pruning + Water spray + Split application of RDF at twice in a year
36	$P_3G_1F_2$	January month pruning + GA_3 at 10ppm + Split application of RDF at alternative month
37	$P_3G_2F_2$	January month pruning + GA_3 at 20ppm + Split application of RDF at alternative month

38	$P_3G_3F_2$	January month pruning + GA_3 at 30ppm + Split application of RDF at alternative month
39	$P_3G_4F_2$	January month pruning + Nitrobenzene at 2 ml /lt + Split application of RDF at alternative month
40	$P_3G_5F_2$	January month pruning + Nitrobenzene at 2.5ml /lt + Split application of RDF at alternative month
41	$P_3G_6F_2$	January month pruning + Nitrobenzene at 3 ml /lt + Split application of RDF at alternative month
42	$P_3G_7F_2$	January month pruning + Water spray + Split application of RDF at alternative month

Result and Discussion

The soil of the experimental plot was loamy, with slightly acidic in nature. The experimental field is fairly levelled with red sandy loam soil of uniform fertility status. Available nitrogen, phosphorus and potassium of soil at the time of experiment impose are presented in table 2.

After completion of experiment, the available nitrogen, phosphorus and potassium of soil and leaf were analysed and presented in table 3. Off-season pruned plants *i.e.,* September (P_1) at the end of experiment, available primary nutrients *viz*., nitrogen, phosphorus, potash content of soil and leaf was highest (852.43, 462.00, 750.07 kg/ha NPK in soil and 2.32%, 0.50% and 1.58% NPK in leaf respectively) and it was minimum in January pruned plants (679.19, 356.83, 600.95 kg/ha in soil and 6.63%, 0.23%, 1.25% NPK respectively in leaf respectively).

Significant differences were observed in P x F interaction at the end of experiment. Highest available primary nutrients *viz*., nitrogen, phosphorus, potash content of soil and leaf (873.57, 480.05, 777.95 kg/ha NPK in soil and 2.50%, 0.55%, 1.63% NPK in leaf respectively) was highest in plants pruned during September along with split application of fertilizers at alternative month *i.e.,* P_1F_2. and lowest available NPK was recorded in plants pruned during January along with split application of RDF at twice in a year (P_3F_1) (650.14, 340.81, 578.76 kg/ha in soil and 1.57%, 0.20%, 1.22% NPK in leaf respectively). The increase in soil and leaf nutrient contents might be due to regular application RDF. Split application of RDF helps the higher nutrient availability thereby causing higher uptake, lower losses through leaching and mineralization. Further, this might have helped in narrowing the C:N ratio in soil and thereby enhanced decomposition of organic residues, which finally increased the availability of other nutrients. The same was depicted by Sanas *et al*. (2018) [11] in *Chrysanthemum coronarium;* Kode *et al.* (2015) [8] in rose and Joshi *et al.* (2012) [6] in chrysanthemum**.**

The data on available NPK in soil and leaf at the end of experiment as influenced by different month of pruning, growth regulators, split application of fertilizers and their interaction (G, F, P x G, G x F and P x G x F) are statistically not significant among the different treatments.

Table 2: Available N, P and K in soil and leaf nutrient content before imposing of experiment

Particulars	Values
Soil type	Red sandy loam soil
Soil pH.	6.50
EC (dsm^{-1})	0.60
OC (per cent)	0.61%
N (kg/ha)	698.33
P (kg/ha)	248.50
K (kg/ha)	526.60

Table 3: Available N, P and K in soil and leaf nutrient content as influenced by pruning, growth regulators and fertilizers after completion of experiment

Treatments	Soil					Leaf		
	pH	E.C (dsm^{-1})	Available N (Kg/ha)	Available P (Kg/ha)	Available K (Kg/ha)	Total N (%)	Total P (%)	Total K (%)
Pruning (P)								
P_1	6.56	0.73	852.43	462.00	750.07	2.32	0.50	1.58
P_2	6.58	0.71	741.86	380.45	669.57	1.84	0.35	1.38
P_3	6.61	0.75	679.19	356.83	600.95	1.63	0.23	1.25
S.Em. ±	NS	NS	2.60	1.82	1.92	0.02	0.01	0.01
C.D@5%	NS	NS	7.32	5.13	5.39	0.05	0.01	0.02
Growth regulators (G)								
G_1	6.56	0.74	760.50	401.67	672.56	1.93	0.36	1.41
G_2	6.59	0.73	761.83	400.39	672.00	1.95	0.37	1.40
G_3	6.59	0.74	758.33	401.50	672.44	1.92	0.35	1.40
G_4	6.56	0.70	759.56	397.61	675.22	1.94	0.36	1.41
G_5	6.49	0.73	755.00	399.94	675.11	1.90	0.36	1.40
G_6	6.69	0.72	756.11	398.22	674.72	1.92	0.38	1.40
G_7	6.60	0.74	753.44	399.00	672.67	1.94	0.36	1.41
S.Em. ±	NS	NS	NS	NS	NS	NS	NS	NS
C.D@5%	NS	NS	NS	NS	NS	NS	NS	NS
Fertilizers (F)								
F_1	6.56	0.71	734.17	379.24	650.90	1.82	0.32	1.36
F_2	6.61	0.74	781.48	420.29	696.16	2.04	0.41	1.45
S.Em. ±	NS	NS	2.12	1.49	1.56	0.01	0.00	0.00
C.D@5%	NS	NS	5.98	4.19	4.40	0.04	0.01	0.01
P x G								
P_1G_1	6.46	0.74	856.50	462.17	745.50	2.34	0.48	1.60
P_1G_2	6.47	0.69	854.67	464.33	748.83	2.31	0.50	1.56
P_1G_3	6.54	0.75	851.83	463.83	747.83	2.27	0.48	1.58
P_1G_4	6.52	0.67	851.83	459.67	755.17	2.33	0.49	1.59
P_1G_5	6.48	0.74	853.67	463.50	752.17	2.29	0.50	1.57

P_1G_6	6.77	0.71	852.67	462.67	754.50	2.33	0.53	1.57
P_1G_7	6.69	0.78	845.83	457.83	746.50	2.39	0.51	1.59
P_2G_1	6.62	0.71	739.33	386.17	669.67	1.83	0.36	1.38
P_2G_2	6.60	0.74	741.17	380.00	669.83	1.87	0.35	1.40
P_2G_3	6.66	0.72	742.67	386.17	671.50	1.86	0.34	1.37
P_2G_4	6.47	0.68	743.17	376.00	668.33	1.86	0.35	1.39
P_2G_5	6.52	0.69	742.00	379.83	671.33	1.80	0.36	1.38
P_2G_6	6.60	0.71	743.00	375.50	667.33	1.82	0.36	1.37
P_2G_7	6.57	0.71	741.67	379.50	669.00	1.82	0.35	1.38
P_3G_1	6.60	0.77	685.67	356.67	602.50	1.64	0.23	1.24
P_3G_2	6.70	0.78	689.67	356.83	597.33	1.67	0.26	1.25
P_3G_3	6.58	0.74	680.50	354.50	598.00	1.64	0.22	1.24
P_3G_4	6.68	0.74	683.67	357.17	602.17	1.62	0.23	1.26
P_3G_5	6.47	0.75	669.33	356.50	601.83	1.61	0.23	1.26
P_3G_6	6.69	0.75	672.67	356.50	602.33	1.61	0.24	1.26
P_3G_7	6.56	0.72	672.83	359.67	602.50	1.62	0.24	1.26
S.Em. ±	NS	NS	NS	NS	NS	NS	NS	NS
C.D@5%	NS	NS	NS	NS	NS	NS	NS	NS
P x F								
P_1F_1	6.54	0.70	831.29	443.95	722.19	2.14	0.44	1.53
P_1F_2	6.59	0.75	873.57	480.05	777.95	2.50	0.55	1.63
P_2F_1	6.53	0.68	721.10	352.95	651.76	1.73	0.31	1.33
P_2F_2	6.62	0.74	762.62	407.95	687.38	1.94	0.39	1.43
P_3F_1	6.61	0.76	650.14	340.81	578.76	1.57	0.20	1.22
P_3F_2	6.61	0.74	708.24	372.86	623.14	1.69	0.27	1.28
S.Em. ±	NS	NS	3.68	2.58	2.71	0.02	0.01	0.01
C.D@5%	NS	NS	10.35	7.26	7.62	0.06	0.02	0.02
G x F								
G_1F_1	6.56	0.75	736.44	381.33	650.56	1.83	0.31	1.36
G_2F_1	6.55	0.73	738.89	379.67	651.11	1.84	0.33	1.36
G_3F_1	6.53	0.75	731.44	382.44	649.78	1.79	0.30	1.34
G_4F_1	6.61	0.64	735.78	376.11	650.89	1.84	0.31	1.38
G_5F_1	6.38	0.69	731.89	379.78	652.67	1.77	0.32	1.36
G_6F_1	4.51	0.47	568.44	308.44	503.00	1.55	0.35	1.05
G_7F_1	4.46	0.52	563.89	305.22	497.67	1.59	0.34	1.06
G_1F_2	6.56	0.72	784.56	422.00	694.56	2.03	0.41	1.45
G_2F_2	6.63	0.74	784.78	421.11	692.89	2.06	0.41	1.44
G_3F_2	6.66	0.73	785.22	420.56	695.11	2.06	0.39	1.45
G_4F_2	6.51	0.75	783.33	419.11	699.56	2.03	0.40	1.45
G_5F_2	6.61	0.76	778.11	420.11	697.56	2.03	0.40	1.44
G_6F_2	6.71	0.76	780.33	419.89	697.33	2.03	0.41	1.45
G_7F_2	6.57	0.75	774.00	419.22	696.11	2.05	0.41	1.45
S.Em. ±	NS	NS	NS	NS	NS	NS	NS	NS
C.D@5%	NS	NS	NS	NS	NS	NS	NS	NS
P x G x N								
$P_1G_1F_1$	6.43	0.74	835.33	445.00	718.33	2.17	0.41	1.55
$P_1G_2F_1$	6.33	0.69	835.00	446.67	726.33	2.13	0.46	1.52
$P_1G_3F_1$	6.43	0.76	830.00	448.67	722.00	2.03	0.42	1.53
$P_1G_4F_1$	6.72	0.58	828.00	438.33	725.67	2.20	0.44	1.55
$P_1G_5F_1$	6.53	0.71	832.33	447.00	723.67	2.06	0.44	1.50
$P_1G_6F_1$	6.77	0.65	831.67	443.00	722.67	2.16	0.48	1.52
$P_1G_7F_1$	6.54	0.75	826.67	439.00	716.67	2.23	0.45	1.53
$P_1G_1F_2$	6.48	0.74	877.67	479.33	772.67	2.50	0.55	1.64
$P_1G_2F_2$	6.61	0.68	874.33	482.00	771.33	2.49	0.54	1.60
$P_1G_3F_2$	6.65	0.74	873.67	479.00	773.67	2.50	0.54	1.63
$P_1G_4F_2$	6.32	0.76	875.67	481.00	784.67	2.46	0.54	1.62
$P_1G_5F_2$	6.43	0.77	875.00	480.00	780.67	2.51	0.56	1.63
$P_1G_6F_2$	6.78	0.76	873.67	482.33	786.33	2.49	0.58	1.62
$P_1G_7F_2$	6.83	0.81	865.00	476.67	776.33	2.54	0.56	1.66
$P_2G_1F_1$	6.55	0.74	720.67	360.67	653.33	1.74	0.32	1.33
$P_2G_2F_1$	6.50	0.74	722.33	353.33	651.33	1.76	0.31	1.36
$P_2G_3F_1$	6.57	0.68	719.67	361.67	653.33	1.73	0.30	1.30
$P_2G_4F_1$	6.50	0.60	717.33	348.00	650.00	1.76	0.31	1.35
$P_2G_5F_1$	6.37	0.62	722.33	350.67	654.67	1.70	0.33	1.34
$P_2G_6F_1$	6.52	0.65	720.33	347.33	650.33	1.71	0.32	1.31
$P_2G_7F_1$	6.72	0.69	725.00	349.00	649.33	1.73	0.31	1.34
$P_2G_1F_2$	6.70	0.67	758.00	411.67	686.00	1.92	0.40	1.43

$P_2G_2F_2$	6.70	0.73	760.00	406.67	688.33	1.98	0.39	1.44
$P_2G_3F_2$	6.75	0.75	765.67	410.67	689.67	2.00	0.38	1.45
$P_2G_4F_2$	6.44	0.77	769.00	404.00	686.67	1.96	0.40	1.42
$P_2G_5F_2$	6.68	0.75	761.67	409.00	688.00	1.89	0.39	1.42
$P_2G_6F_2$	6.69	0.77	765.67	403.67	684.33	1.93	0.41	1.43
$P_2G_7F_2$	6.41	0.74	758.33	410.00	688.67	1.90	0.39	1.41
$P_3G_1F_1$	6.69	0.78	653.33	338.33	580.00	1.59	0.20	1.21
$P_3G_2F_1$	6.82	0.76	659.33	339.00	575.67	1.63	0.21	1.21
$P_3G_3F_1$	6.57	0.79	644.67	337.00	574.00	1.60	0.18	1.21
$P_3G_4F_1$	6.60	0.75	662.00	342.00	577.00	1.56	0.19	1.23
$P_3G_5F_1$	6.23	0.75	641.00	341.67	579.67	1.53	0.20	1.24
$P_3G_6F_1$	6.72	0.75	643.67	339.33	583.33	1.55	0.22	1.22
$P_3G_7F_1$	6.65	0.75	647.00	348.33	581.67	1.53	0.19	1.23
$P_3G_1F_2$	6.51	0.76	718.00	375.00	625.00	1.68	0.27	1.27
$P_3G_2F_2$	6.58	0.80	720.00	374.67	619.00	1.70	0.30	1.28
$P_3G_3F_2$	6.58	0.70	716.33	372.00	622.00	1.69	0.26	1.28
$P_3G_4F_2$	6.77	0.73	705.33	372.33	627.33	1.68	0.27	1.30
$P_3G_5F_2$	6.71	0.75	697.67	371.33	624.00	1.69	0.25	1.28
$P_3G_6F_2$	6.66	0.75	701.67	373.67	621.33	1.68	0.26	1.30
$P_3G_7F_2$	6.47	0.70	698.67	371.00	623.33	1.70	0.28	1.29
S.Em. ±	NS	NS	NS	NS	NS	NS	NS	NS
C.D@5%	NS	NS	NS	NS	NS	NS	NS	NS

P_1 – September pruning
P_2 – November pruning
P_3 – January pruning (Control)
G_1 - GA_3 at 10ppm G_2 - GA_3 at 20ppm
G_3 - GA_3 at 30ppm G_4 - Nitrobenzene at 2 ml /l
G_5 - Nitrobenzene at 2.5 ml /l
G_6 - Nitrobenzene at 3 ml /l
G_7 – Water spray (control)
F_1- Application of RDF twice in a year (Oct and Mar)
F_2- Split application of RDF at alternative month (at a dose of 10:20:20 N: P: K during July, Sep, Nov, Jan, Mar, May)

Conclusion

September month pruning, foliar spray of nitrobenzene at 3ml/l along with split application of fertilizers at alternative month will help the farmer for getting a higher flower yield with enhancing soil and leaf NPK.

Acknowledgement

Special thanks to DST-INSPIRE Fellowship, for financial assistant for conducting research.

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